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16-342-6211 T=187 2 001 F=126 18:38AM FROM-MERC-UNT & SOULD F C 701 Fifth Avenue, Suite 4100 Samle, Washington Merchant & Gould 90101-7097 USA An Intellectual Property Law Furm res 206.3+2.6200 FAT 200.347.6201 www.menchant-phuld.com Fax Transmission FRUM: Brett A. Henzberg Commissioner for Patents ATTN: Terry Lee England P.O. Box 1450 OUR REF: 50019.273US01/P05808 (DAI Vob) Alexandria, VA 22313-1450 PTO FAX NUMBER 1-571-273-8300 Total pages, including ocver letter: CURVATURE CORRECTED BANDGAP CIRCUIT Siew Siong Teo Appl cent: Serial No.: 10/808,635 March 24, 2004 Filed: Group Art Unit: Our Ref. No.: Confirmation No. 50019,273US01/P05808 Attached is a resubmission of a filing, previously received by the PTO on January 22, 2007. The Amendment was inadvertently faxed unsigned Attached please find the signed Amendment together with copies of the PTO Auto-Reply Facsimile Transmission and Fax Coversheet as filed on January 22, Ploase charge any additional fees or credit overpayment to Deposit Account No. 13-2725 Please consider this a PETITION FOR EXTENSION OF TIME for a sufficient number of months to enter those papers, if appropriate. I heraby certify that this paper is being transmitted by facsimile to the U.S. Patent and Trademark Office on the date shown below. Dalact February 6, 2007 If you do NCT receive all of the pages, please telephone us at 206.342.6200, or fax us at 206.342.6201.

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TO: Commissioner for Patents

ATTN: Terry Lee Englund

P.O. Box 1450

Alexandria, VA 22313-1450

FROM: OUR REF: Brett A. Hertzberg 50019.273US01/P05808

(BAH/ab)



PTO FAX NUMBER 1-571-273-8300

Total pages, including cover letter:

17

Title:

CURVATURE CORRECTED BANDGAP CIRCUIT

Applicant:

Siew Siong Teo 10/808,635

Serial No.: Filed:

March 24, 2004

Group Art Unit:

<u> 2838</u>

Our Ref. No.:

50019.273US01/P05808

Confirmation No.

6093

Attached is a resubmission of a filing, previously received by the PTO on January 22, 2007. The Amendment was inadvertently faxed unsigned.

Attached please find the signed Amendment together with copies of the PTO Auto-Reply Facsimile Transmission and Fax Coversheet as filed on January 22, 2007.

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Dated: February 6, 2007

Name: Brett A. Hertzberg

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COPY

S/N 10/808,635

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:

Siew Siong Teo

Examiner:

Terry Lee Englund

Application No.:

10/808,635

Group Art Unit:

2816

Filed:

March 24, 2004

Docket No.:

50019.273US01/P05808

Title:

CURVATURE CORRECTED BANDGAP CIRCUIT

CERTIFICATE UNDER 37 CFR 1.6(d): I hereby certify that this correspondence is being sent via facsimile to (571)-273-8300, Commissioner for Patents, ATTN: Examiner Terry Lee Englund, P.O. Box 1450, Alexandria, VA 22313-1450 on January 22, 2007.

Name: Brett A. Hertzbe

AMENDMENT

VIA FACSIMILE #571-273-8300

Commissioner for Patents

ATTN: Examiner Terry Lee Englund

P.O. Box 1450

Alexandria, VA 22313-1450

Dear Sir:

In response to the Office Action of October 20, 2006, please amend the above-identified application as follows:

Amendments to the Specification begin on page 2 of this paper.

Amendments to the Claims are reflected in the listing of claims which begins on page 4 of this paper.

Replacement Drawings are found on page 9 of this paper.

Remarks/Arguments begin on page 10 of this paper.

In the Specification

Please replace the paragraph beginning on page 1, line 20 as follows:

"An example of a modern band-gap reference circuit is illustrated as circuit 500 in FIGURE 5. As shown in the figure, two bipolar transistors (Q1, Q2) are arranged with a common base that is connected to VDD. Two resistors (R1, R2) are series connected between the emitter of the first bipolar transistor (Q1) and the reference output (VREF). Another resistor (R3) is connected between the emitter of the second bipolar transistor (Q2) and the reference output (VREF). An error amplifier (EAMP) is used to adjust the voltage of the reference output (VREF) through feedback. At steady-state, the voltage at the common point of resistors R1 and R2 is the same as the voltage at the emitter of the second bipolar transistor (Q2). The two bipolar transistors (Q1, Q2) are arranged to provide a ten-to-one (10:1) current density difference with respect to one another (Q2 to Q1). The ten-to-one current density results in a 60mV difference between the base-emitter voltages of two bipolar transistors ($\Delta Vbe = Vt*ln(A1/A2) =$ 26mV*ln(10) = 60mV, at room temperature. A1 and A2 are the respective emitter areas of bipolar transistors Q1 and Q2. Current I1 is set to equal current I2 by means of resistors R2, R3, and feedback operation of error amplifier EAMP. The 60mV difference appears across the first resistor (R1). The voltage between VDD and the output of the error amplifier corresponds to a reference voltage (VREF) that is given as VREF = Vbe + X*Vt, where X is a constant that is used to scale the temperature correction factor. The temperature correction factor (X) is adjusted by the ratio of the resistors ((R2/R1)*ln(A1/A2)). Typical temperature corrected reference voltages of 1.25V are achieved by this configuration."

Please replace the abstract of the disclosure with the following paragraph:

"An apparatus and method provide for curvature corrected temperature variations in a band-gap reference circuit. The apparatus includes a band-gap cell, an IPTAT circuit, a resistor, and a feedback circuit. The band-gap cell is arranged to provide a band-gap voltage. The resistor circuit is coupled to both the band-gap cell and the IPTAT circuit. The feedback circuit is arranged to selectively activate the IPTAT circuit such that an additional correction factor is added to the temperature response of the band-gap cell to provide a second order curve. The IPTAT circuit can be implemented as a simple transistor that is responsive to changes in absolute temperature."

Listing of claims:

1. (Currently Amended) An apparatus for providing a temperature compensated reference signal, comprising:

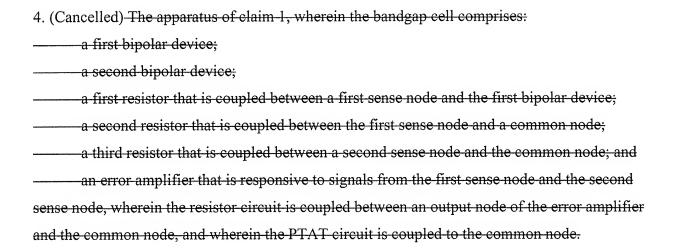
a bang-gap band-gap cell that is arranged to provide a first signal that has a first temperature response profile at a first node, wherein the band-gap cell comprises a first bipolar device, a second bipolar device, a first resistor that is coupled between a first sense node and the first bipolar device, a second resistor that is coupled between the first sense node and a common node, a third resistor that is coupled between the common node and the second bipolar device at a second sense node, and an error amplifier that is responsive to signals from the first sense node and the second sense node, wherein the resistor circuit is coupled between an output node of the error amplifier and the common node;

a PTAT circuit that is arranged to selectively provide a second signal that has a second temperature response profile to the common node when active;

a feedback circuit that is arranged to selectively activate the PTAT circuit in response to an output from the band-gap cell; and

a resistor circuit that is <u>coupled</u> between the output from the band-gap circuit and the <u>common node</u>, wherein the resistor circuit is arranged in cooperation with the band-gap cell and the PTAT circuit to generate the temperature compensated reference signal at the common node <u>as a combination of the first signal and the second signal</u> such that the temperature compensated reference signal has a third temperature response profile that is determined by <u>combination of the first temperature response</u> profile and the second temperature response profile.

- 2. (Currently Amended) The apparatus of claim 1, wherein the first temperature response profile is different from the second temperature response profile._-such that the third temperature response profile
- 3. (Original) The apparatus of claim 1, wherein the first signal and the second signal are currents, and wherein the resistor circuit is arranged to combine the currents that are associated with the first and second signals.



- 5. (Currently Amended) The apparatus of claim [4] $\underline{1}$, wherein the first bipolar device and the second bipolar device are ratio scaled with respect to one another.
- 6. (Original) The apparatus of claim 1, wherein the feedback circuit comprises at least one of: a passive feedback circuit, an active feedback circuit, a voltage divider circuit, a gain scaling circuit, a resistor divider circuit, a capacitive divider circuit, and a stacked diode circuit.
- 7. (Original) The apparatus of claim 1, wherein the feedback circuit corresponds to a voltage divider circuit that senses the output of the band-gap cell.
- 8. (Original) The apparatus of claim 1, wherein the PTAT circuit comprises at least one of: a voltage reference circuit that is configured to provide the second signal as a voltage, and a current reference circuit that is configured to provide the second signal as a current.
- 9. (Original) The apparatus of claim 1, wherein the PTAT circuit includes a bipolar junction device that is arranged to provide the second signal as a current that is proportional to absolute temperature.

- 10. (Original) The apparatus of claim 1, wherein the PTAT circuit includes a bipolar junction device that is arranged to provide the second signal as a voltage that is proportional to absolute temperature.
- 11. (Original) The apparatus of claim 1, wherein the PTAT circuit is arranged to activate when an operating temperature associated with the apparatus reaches a temperature trip point.
- 12. (Original) The apparatus of claim 1, wherein the band-gap cell is referenced from at least one of: a high supply signal, a low supply signal, and a ground reference signal.
- 13. (Original) The apparatus of claim 1, wherein the temperature compensated reference signal corresponds to at least one of a current and a voltage.
- 14. (Currently Amended) An apparatus for providing a temperature compensated reference signal, comprising:
- a bang-gap band-gap cell means that is coupled between first common node and a power supply node, wherein the band-gap cell means is arranged to provide a first signal that has a first temperature response profile at the first common node, wherein the band-gap cell means is also arranged to provide an output at a second common node;
- a PTAT means that is arranged to selectively provide a second signal that has a second temperature response profile at the first common node when active, wherein the second temperature response profile is proportional to absolute temperature;
- a sense means that is arranged to sense-an the output of the band-gap cell means at the second common node and selectively activate the PTAT means in response to the sensed output; and
- a signal combination resistor means that is coupled between the second common node and the first common node, wherein the signal combination means is arranged to adjust the temperature compensated reference signal in response to combine the first signal and the second signal at the first common node such that the output of the band-gap cell at the second common

<u>node corresponds to a temperature compensated reference signal has with a third temperature</u> response profile that is determined by <u>combination of</u> the first temperature response profile and the second temperature response profile.

- 15. (Currently Amended) The apparatus of claim 14 12, wherein the PTAT means comprises at least one of: a voltage reference means that is configured to provide the second signal as a voltage, and a current reference means that is configured to provide the second signal as a current.
- 16. (Currently Amended) The apparatus of claim <u>14 12</u>, wherein the PTAT means is arranged such that the second temperature response profile is proportional to absolute temperature.
- 17. (Currently Amended) The apparatus of claim <u>14</u> <u>12</u>, wherein the band-gap cell means is reference referenced at the power supply node from at least one of: a high supply signal, a low supply signal, and a ground reference signal.
- 18. (Currently Amended) The apparatus of claim <u>14</u> <u>12</u>, wherein the temperature compensated reference signal corresponds to at least one of a current and a voltage.
- 19. (Currently Amended) A method for providing a temperature compensated reference signal, comprising:

coupling a band-gap cell between a first common node and a power supply node; coupling a resistor between the first common node and a second common node;

providing a band-gap voltage from the a band-gap cell at the second common node when the band-gap cell is active, wherein the band-gap cell is arranged to operate with that has a first temperature profile;

monitoring voltages at the second common node with a voltage divider to provide a feedback signal that is responsive to changes in the band-gap voltage to provide a feedback signal;

coupling the feedback signal to <u>an input of</u> a PTAT circuit that has a second temperature profile;

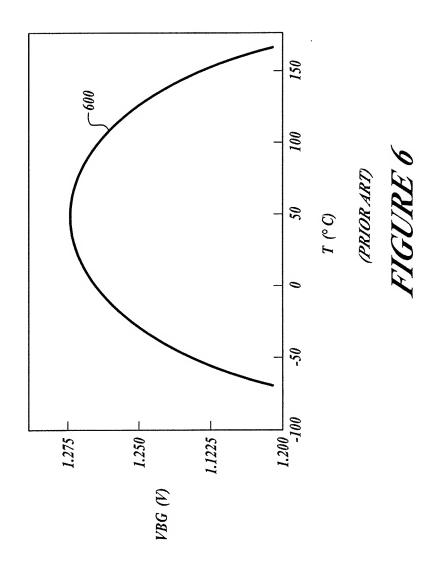
activating the PTAT circuit in response to the feedback signal when an operating temperature associated with the band-gap cell PTAT circuit reaches a temperature trip-point; and coupling a-an output signal from the PTAT circuit to the first common node the band-gap cell when the PTAT circuit is active such that the temperature profile associated with the bang-gap voltage is modified by the PTAT circuit to create a third temperature profile that corresponds to the combined temperature profiles of the band-gap cell and the PTAT circuit is provided to the band-gap voltage.

20. (Original) The method of claim 19, wherein the first temperature profile corresponds to a band-gap curve, the second temperature profile corresponds to a proportional to absolute temperature curve, and the third temperature profile corresponds to a curvature corrected band-gap curve.

REPLACEMENT DRAWING

Title: CURVATURE CORRECTED BANDGAP CIRCUIT
Inventors: Siew Siong Teo
Application No.: 10/808,635 Docket No.: 50019.273US01/P05808
REPLACEMENT SHEET

6/6



REMARKS/ARGUMENTS

Claims 1-20 are pending in the present application. The drawings and abstract are

object to for various informalities. Claims 1 - 18 are objected to. Claims 1 - 20 are rejected.

Claims 1, 2, 5, and 14 – 19 are amended. Claim 4 is cancelled. No new matter is added.

Objection to the Drawings

FIG. 5 is objected to for failing to comply with 37 CFR 1.84(p)(5). In particular, FIG. 5

lacks a label for the term "VOUT" that is described in the specification, and also because FIG. 5

includes a reference label "500" that is properly referenced in the specification. The

specification has been amended to remove the label "VOUT" in favor of label "VREF", which is

already included in FIG. 5. The specification has also been amended to include the reference to

label "500", which simply refers to the entire circuit schematic. It is believed that the objection

to FIG. 5 is overcome by this amendment and notice to that effect is requested.

FIG. 6 is objected to for failing to have a designation of "PRIOR ART". A replacement

sheet for FIG. 6 is included with this response, where the replacement sheet has the designation

of "PRIOR ART." It is believed that the objection to FIG. 6 is overcome by this amendment and

notice to that effect is requested.

Objection to the Specification

The abstract of the disclosure is objected to for describing various merits of the invention,

and for including a customer number that is not necessary. In accordance with the Examiner's

request, the abstract of the disclosure has been amended to remove the last sentence, and also

Page 10 of 14

remove the customer number. It is believed that the objection to specification is overcome by this

amendment and notice to that effect is requested.

Objection to the Claims

Claims 1 – 18 are objected to for various informalities. In particular claims 1, 14 and 15

have been objected to for various typographical errors that are now corrected by way of

amendment.

Rejection of the Claims under 35 U.S.C. § 112

Claims 1 – 20 are objected to under 35 U.S.C. § 112, second paragraph as being

indefinite for failing to particularly point out and distinctly claim the subject matter which the

Applicant regards as the invention. In particular, the Examiner noted points of confusion or

errors with regard to claims 1, 2, 4, and 15 - 17.

Applicants wish to thank the Examiner for such a thorough review. Claim 4 is cancelled,

and claims 1, 2 and 15-17 are amended. It is believed that the rejection of the claims under 35

U.S.C. § 112 is overcome, and notice to that effect is kindly requested.

Applicant has reviewed each of the pending claims, and further amended claim 18 to

properly depend from claim 14 instead of claim 12.

Allowable Subject Matter

Claims 4-5 are indicated as allowable if rewritten to overcome the objections and

rejections under 35 U.S.C. § 112. Claim 4 has been cancelled and its limitations have been

properly incorporated into now amended claim 1. Claims 2, 3 and 5-13 now properly depend

Page 11 of 14

from claim 1 and are thus also propsed to be allowable. Therefore, it is believed that claims 1 - 3 and 5 - 13 are in proper form for allowance, and notice to that effect is requested.

Rejection of the Claims under 35 U.S.C. § 102

Claims 1-3 and 6-20 are rejected under 35 U.S.C. § 102, second paragraph as being anticipated by U.S. Patent No. 4,939,442 (the '442 patent) to Carvajal et al. Claims 1-13 are considered allowable for the reasons previously stated above. Claims 14-20 are further proposed to be allowable for the reasons stated below.

Claim 14 as amended includes at least the following limitations not disclosed, taught or otherwise suggested in the '442 patent:

"a signal combination resistor means that is coupled between the second common node and the first common node, wherein the signal combination means is arranged to adjust the temperature compensated reference signal in response to combine the first signal and the second signal at the first common node such that the output of the bandgap cell at the second common node corresponds to a temperature compensated reference signal has with a third temperature response profile that is determined by combination of the first temperature response profile and the second temperature response profile."

The '442 patent does not teach coupling a resistor means between the second common node and the first common mode, where the resistor means is arranged to combine two signals with different temperature response profiles. Since these features, as they relate to the other structural features are not described or otherwise taught in the '442 reference, it is believe that claim 14 is allowable for at least that reason. Claims 15 – 18 depend upon and further limit claim 14, and are thus also believed to be allowable. Claims 14 – 18 are now in proper form for allowance and notice to that effect is requested.

Claim 19 as amended includes at least the following limitations not disclosed, taught or otherwise suggested in the '442 patent:

"coupling a band-gap cell between a first common node and a power supply node;"

"coupling a resistor between the first common node and a second common node;"

"monitoring voltages at the second common node with a voltage divider to

provide a feedback signal that is responsive to changes in the band-gap voltage;"

"coupling an output signal from the PTAT circuit to the first common node when the PTAT circuit is active such that the temperature profile associated with the bang-gap voltage is modified by the PTAT circuit to create a third temperature profile that corresponds to the combined temperature profiles of the band-gap cell and the PTAT circuit."

The '442 patent does not teach coupling a resistor between the first common node and the second common mode, nor does the '442 patent teach monitoring voltages at the second common node with a voltage divider to provide the feedback signal responsive to changes in the band-gap voltage. Moreover, the other described claim elements in Applicant's amended claim 19 includes steps that require additional structural connectivity such as, for example, the band-gap cell being coupled to the resistor, which in effect couples the signals together, at two places (i.e., the second common node and the first common node). Since these features, as they relate to the other structural features are not described or otherwise taught in the '442 reference, it is believe that claim 19 is allowable for at least that reason. Claim 20 depends upon and further limit claim 19, and are thus also believed to be allowable. Claims 19 – 20 are now in proper form for allowance and notice to that effect is requested.

In view of the foregoing amendments and remarks, all pending claims are believed to be allowable and the application is in condition for allowance. Therefore, a Notice of Allowance is respectfully requested. Should the Examiner have any further issues regarding this application, the Examiner is requested to contact the undersigned attorney for the applicant at the telephone number provided below.

Respectfully submitted,

MERCHANT & GOULD P.C.

Brett A. Hertzberg

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201-342-1201 T-844 F SC1 F-915 701 Fifth Avenue, State 4100 Merchant & Gould Scale Wichniger 28104-7077 USA At latelledus Property Law Firm 17. 206.347.0200 HXX 2005.342 0201 w-cechant-gould.com A Professional Companyon Fax Transmission | Jamuary 22, 2007 Commissioner for Patents FROM: Brett A. Heitzberg P.O. Box 1450 Alexandria, VA 223:3-1450 OUR REF: 50019273US01/P05808 [BAHVzh] Total pages, including cover letter: PIO FAX NUMBER 1-571-273-8300 If you do NOT receive all of the pages, please telephone us at 206 342,6200, or fax us at Documents Transmitted. Fax Coversheer: Amendment CURVATURE CURRECTED BANDGAP CIRCUIT Applicant: Serial No.; Siew Siong Teo 10/808,635 March 24, 2004 Group Art Unir: 2838 Our Ref. No.: 50019.273US01/P05808 Confirmation No. 6093 Please charge any additional fees or credit overpayment to Deposit Austint No. 13-2725. Please consider this a PETITION FOR EXTENSION OF TIME for a sufficient number of months to eriter these papers, if appropriate. I hereby certify that this paper is being transmitted by facsimile to the U.S. Patent and Trademerk Office on the cete shown below. Dated: January 22, 2007 PAGE 10.21 RCYO AT 1/22/2011 10.2010 1 PM (Eastern Stanford Time) 1 SYR:USPTO-EFXER-5/91 DMS-2718/301 1 CSD:201 142/6/01 1 DURATION (mm-sc):04-32

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January 22, 2007

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Alexandria, VA 22313-1450

FROM: Brett A. Hertzberg

OUR REF: 50019.273US01/P05808

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Documents Transmitted: Fax Coversheet; Amendment

Title:

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Applicant:

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Serial No.:

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Dated: January 22, 2007

Name: Brett A. Her